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In re Patent Application of: Sang-In KIM et al.	Customer No.: 30827
Application No.: 09/730,836	Confirmation No.: 8708
Filed: December 7, 2000	Art Unit: 2871
For: METHOD OF FABRICATING LIQUID CRYSTAL DISPLAY	Examiner: Thoi V. Duong

SUBMISSION OF VERIFIED ENGLISH TRANSLATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Attached is an executed Statutory Declaration of Kyung Gu Kang, along with the verified English translation of Korean Priority Application No. 10-1999-0058748, which was filed on December 7, 2000 in the U.S. Patent and Trademark Office.

Dated: March 9, 2006

Respectfully submitted,

By _____
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STATUTORY DECLARATION

I, Kyung Gu KANG, a citizen of the Republic of Korea and a staff member of Y.H.KIM INTERNATIONAL PATENT & LAW OFFICE specializing in "METHOD OF FABRICATING LIQUID CRYSTAL DISPLAY" do hereby declare that:

I am conversant with the English and Korean languages and a competent translator thereof.

To the best of my knowledge and belief, the following is a true and correct translation of the Relativity Document (No. P1999-58748) in the Korean language already filed with Korean Industrial Property Office on December 17, 1999.

Signed this 6th day of March, 2006

Kyung Gu KANG

PATENT APPLICATION

DOCUMENT NAME: PATENT APPLICATION

TO: COMMISSIONER

DATE: December 17, 1999

TITLE OF THE INVENTION: METHOD OF FABRICATING LIQUID CRYSTAL DISPLAY

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The present application is filed pursuant to Article 42 of the Korea Patent Act.

Patent Attorney

Young Ho KIM

[ABSTRACTS]

[ABSTRACT]

This invention relates to a method of fabricating a liquid crystal display, and more particularly to a method of fabricating a liquid crystal display (LCD) including a thin film transistor having gate electrodes, a gate insulating film, an active layer, an ohmic contact layer and source and drain electrodes. In the method, a passivation layer made from an organic insulation material is formed on a transparent substrate to cover the thin film transistors. The passivation layer is patterned to define a contact hole for exposing the drain electrode, and the surface of the passivation layer is cleaned with an ultraviolet ray to form a buffer layer having a hydrophile property. A pixel electrode is formed on the buffer layer in such a manner to be contacted with the drain electrode via the contact hole.

Accordingly, a method of fabricating a liquid crystal display wherein a buffer layer having a hydrophile property is provided at the surface of a passivation layer having a hydrophobic property at a normal pressure to shorten a process time.

[REPRESENTATIVE DRAWING]

Fig. 2d

[SPECIFICATION]

[TITLE OF THE INVENTION]

METHOD OF FABRICATING LIQUID CRYSTAL DISPLAY

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1a to Fig. 1e are section views showing a conventional process of fabricating a liquid crystal display; and

Fig. 2a to Fig. 2e are section views showing a process of fabricating a liquid crystal display according to an embodiment of the present invention.

<DETAILED DESCRIPTION OF THE REFERENCE NUMERALS>

31: transparent substrate
33: gate electrode
35: gate insulating film
37: active layer
39: ohmic contact layer
41, 43: source and drain electrodes
45: passivation layer
47: contact hole
49: buffer layer
51: pixel electrode

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[TECHNICAL FIELD INCLUDING THE INVENTION AND PRIOR ART THEREIN]

This invention relates to a method of fabricating a liquid crystal display, and more particularly to a method of fabricating a liquid crystal display (LCD) wherein an adhesive force of a passivation layer to a pixel electrode is enhanced to prevent the pixel electrode from being overetched and hence reduced in size.

Generally, a liquid crystal display (LCD) includes switching devices consisting of thin film transistors having gate electrodes, a gate insulating film, an active layer, an ohmic contact layer and source and drain electrodes, and a liquid crystal injected between a lower plate provided with pixel electrodes and an upper plate provided with color filters.

In the LCD, N×M unit pixels (wherein N and M are integers), each of which consists of a thin film transistors as a switching device and a pixel electrode coupled with the thin film transistor, are vertically and horizontally arranged in a matrix type. N gate lines and M data lines transmitting signals to the gate electrodes and the drain electrodes of the thin film transistors, respectively are formed in such a manner to cross each other.

The pixel electrodes overlap with the data lines and the gate lines so as to increase an aperture ratio of the

LCD. In overlapping the pixel electrodes with the data lines, a passivation layer is formed from an organic insulation material having a small dielectric constant such as BCB (β-stagged-divinyl-siloxane-benzocyclobutene), acrylic organic compound or PFCB (perfluorocyclobutane) to reduce a parasitic capacitance.

Figs. 1a to 1e show a process of fabricating a conventional LCD.

Referring to Fig. 1a, aluminum (Al) or a copper (Cu) is deposited on a transparent substrate 11 by the sputtering technique to form a metal thin film. The metal thin film is patterned to be left to only a desired portion of the transparent substrate 11 by the photolithography including a wet method, thereby forming a gate electrode 13.

Referring to Fig. 1b, a gate insulating film 15, an active layer 17 and an ohmic contact layer 19 are sequentially formed on the transparent substrate 11 by the chemical vapor deposition (CVD) technique in such a manner to cover the gate electrode 13. The gate insulating film 15 is formed by a deposition of an insulation material such as silicon oxide or silicon nitride, and the active layer 17 is formed from an amorphous silicon or a polycrystalline silicon that is not doped with an impurity. The ohmic contact layer 19 is made from an amorphous silicon or a

polycrystalline silicon doped with a n-type or p-type impurity at a high concentration.

A desired portion of the ohmic contact layer 19 and the active layer 17 is patterned by the photolithography including an anisotropic etching in such a manner to expose the gate insulating film 15. In this case, the active layer 17 and the ohmic contact layer 19 are left to only a portion corresponding to the gate electrode 13.

Referring to Fig. 1c, a metal such as molybdenum (Mo), chrome (Cr), titanium (Ti) or tantalum (Ta), etc., or a molybdenum alloy such as MoW, MoTa or MoNb, etc. is deposited on the gate insulating film 15 by the CVD or sputtering technique in such a manner to cover an ohmic contact layer 19. The metal or the metal alloy deposited in this manner makes an ohmic contact with the ohmic contact layer 19.

The metal or the metal alloy is patterned by the photolithography to expose the gate insulating film 15, thereby forming source and drain electrodes 21 and 23. In this case, the metal and the metal alloy at a portion corresponding to the gate electrode 13 between the source and drain electrodes 21 and 23 and the ohmic contact layer 19 also are patterned to expose the active layer 17. Said portion corresponding to the gate electrode 13 between the

source and drain electrodes 21 and 23 of the active layer 17 becomes a channel.

Referring to Fig. 1d, an organic insulation material having a small dielectric constant such as acrylic organic compound, BCB or PFCB, etc. is deposited on the transparent substrate 11 to cover the above-mentioned structure, thereby forming a passivation layer 25. In this case, the passivation layer 25 has a hydrophobic property.

Then, the passivation layer 25 is patterned to define a contact hole 27 for exposing the drain electrode 21. The passivation layer 25 is dry ashed in a vacuum state to change the surface thereof into a hydrophile property.

Referring to Fig. 1e, an indium tin oxide (ITO), a tin oxide (TO) or an indium zinc oxide (IZO) of a transparent conductive material is deposited on the passivation layer 25 via the contact hole 27 in such a manner to be contacted with the drain electrode 21. Since the surface of the passivation layer 25 has been changed from a hydrophobic property into a hydrophile property, an adhesive force thereof to the transparent conductive material is improved. Then, the deposited transparent conductive material is patterned by the photolithography using a mixture acid such as HCl, $(COOH)_2$ or $HCl+HNO_3$ as an echant liquid to form a pixel electrode 29.

In the conventional method of fabricating the LCD as described above, the passivation layer having a hydrophobic property is dry ashed in a vacuum state to change the surface thereof into a hydrophile property and thereafter the transparent conductive material, such as ITO, etc., for forming the pixel electrode is deposited. Therefore, the transparent conductive material such as ITO is patterned to have an improved adhesive force to the passivation layer, so that it becomes possible to prevent the pixel electrode from being reduced in size upon formation of the pixel electrode.

However, the conventional method of fabricating the LCD has a problem in that, since the passivation layer must be dry ashed in a vacuum state so as to change the surface thereof from a hydrophobic property into a hydrophile property, a long time is required to make an equipment into a vacuum state and hence a process time is increased.

[TECHNICAL SUBJECT MATTER TO BE SOLVED BY THE INVENTION]

Accordingly, it is an object of the present invention to provide a method of fabricating a liquid crystal display wherein a buffer layer having a hydrophile property is provided at the surface of a passivation layer having a hydrophobic property at a normal pressure to shorten a

process time.

[CONFIGURATION AND OPERATION OF THE INVENTION]

In order to achieve these and other objects of the invention, a method of fabricating a liquid crystal display according to an embodiment of the present invention includes the steps of forming a passivation layer made from an organic insulation material on a transparent substrate to cover the thin film transistors; patterning the passivation layer to define a contact hole for exposing a drain electrode and cleaning the surface of the passivation layer with an ultraviolet ray to form a buffer layer having a hydrophile property; and forming a pixel electrode on the buffer layer in such a manner to be contacted with the drain electrode via the contact hole.

These and other objects of the invention will be apparent from the following detailed description of the embodiments of the present invention with reference to the accompanying drawings, in which:

Fig. 2a to Fig. 2e are section views showing a process of fabricating a liquid crystal display according to an embodiment of the present invention.

Referring to Fig. 2a, an aluminum (Al) or copper (Cu) is deposited on a transparent substrate 31 by the

sputtering technique, etc. or is coated thereon by the electroless plating technique to form a metal thin film. A glass, a quartz or a transparent plastic, etc. may be used as the transparent substrate 31. Then, the metal thin film is patterned to be left to only a desired portion of the transparent substrate 31 by the photolithography including a wet method, thereby forming a gate electrode 33.

Referring to Fig. 2b, a gate insulating film 35, an active layer 37 and an ohmic contact layer 39 are sequentially formed on the transparent substrate 31 by the chemical vapor deposition (CVD) technique in such a manner to cover the gate electrode 33. The gate insulating film 35 is formed by a deposition of an insulation material such as silicon oxide or silicon nitride, and the active layer 37 is formed from an amorphous silicon or a polycrystalline silicon that is not doped with an impurity. The ohmic contact layer 39 is made from an amorphous silicon or a polycrystalline silicon doped with a n-type or p-type impurity at a high concentration.

A desired portion of the ohmic contact layer 39 and the active layer 37 is patterned by the photolithography including an anisotropic etching in such a manner to expose the gate insulating film 35. In this case, the active layer 37 and the ohmic contact layer 39 are left to only a

portion corresponding to the gate electrode 13.

Referring to Fig. 2c, a metal such as molybdenum (Mo), chrome (Cr), titanium (Ti) or tantalum (Ta), etc., or a molybdenum alloy such as MoW, MoTa or MoNb, etc. is deposited on the gate insulating film 15 by the CVD or sputtering technique in such a manner to cover an ohmic contact layer 39. The metal or the metal alloy deposited in this manner makes an ohmic contact with the ohmic contact layer 39.

Then, the metal or the metal alloy is patterned by the photolithography to expose the gate insulating film 35, thereby forming source and drain electrodes 41 and 43. In this case, the metal and the metal alloy at a portion corresponding to the gate electrode 33 between the source and drain electrodes 41 and 43 and the ohmic contact layer 39 also are patterned to expose the active layer 37. Said portion corresponding to the gate electrode 33 between the source and drain electrodes 41 and 43 of the active layer 37 becomes a channel.

Referring to Fig. 2d, a passivation layer 45 covering the above-mentioned structure is provided on the transparent substrate 31. The passivation layer 45 is made from an organic insulation material having a small dielectric constant such as acrylic organic compound, BCB

(β-stagged-divinyl-siloxane-benzocyclobutene) or PFCB (perfluorocyclobutane), etc.

The passivation layer 45 is patterned to define a contact hole 47 for exposing the drain electrode 41. Then, the surface of the passivation layer 45 is cleaned with a ultraviolet (UV) ray of 100 to 200nm at a normal pressure to form a buffer layer 49 having a thickness of about 10 to 50Å made from SiO_2 or other oxide. In this case, the surface of the passivation layer 45 prior to cleaning it with a UV ray has a large contact angle of about 50 to 60° to make a hydrophobic property, but the buffer layer 49 having been cleaned with a UV ray has a small contact angle of less than 10°to be changed into a hydrophile property.

Since a UV ray of about 100 to 200nm has a high energy, an oxygen in the air is excited to be ozonized. In this case, a UV ray passing through the ozonized oxygen cuts a molecular combination at the surface of the organic insulating film making the passivation layer 45 to improve a reaction characteristic. Therefore, the cut-away molecule at the surface of the passivation layer 45 reacts with the ozonized oxygen to form the buffer layer 49 having a hydrophile property made from SiO_2 or other oxide.

The surface of the passivation layer 45 is cleaned with a UV ray at a normal pressure to form the buffer layer

49 of SiO_2 or other oxide having a hydrophile property, so that it becomes possible to simplify the process.

Referring to Fig. 2e, an indium tin oxide (ITO: Indium Tin Oxide), a tin oxide (TO: Tin Oxide) or an indium zinc oxide (IZO: Indium Zinc Oxide) of a transparent conductive material is deposited on the buffer layer 49 via the contact hole 47 in such a manner to be contacted with the drain electrode 41. Since the buffer layer 49 has a hydrophile property, an adhesive force thereof to the deposited transparent conductive material is improved.

Then, the deposited transparent conductive material is patterned by the photolithography using a mixture acid such as HCl, $(COOH)_2$ or $HCl+HNO_3$ as an echant liquid to form a pixel electrode 51. In this case, an adhesive force of the buffer layer 49 to the transparent conductive material is large, so that it becomes possible to restrain the pixel electrode 51 from being overetched and thus reduced in size.

As described above, according to the present invention, the surface of the passivation layer having a hydrophile property is cleaned with a UV ray of about 100 to 200nm at a normal pressure rather than a vacuum state, thereby forming the buffer layer of SiO_2 or other oxide having and a thickness of about 10 to 50Å a hydrophile property.

[EFFECT OF THE INVENTION]

Accordingly, the present method has an advantage in that, since the buffer layer having a hydrophile property is formed on the surface of the passivation layer having a hydrophobic property at a normal pressure, it becomes possible to shorten a process time.

Although the present invention has been explained by the embodiments shown in the drawings described above, it should be understood to the ordinary skilled person in the art that the invention is not limited to the embodiments, but rather that various changes or modifications thereof are possible without departing from the spirit of the invention. Accordingly, the scope of the invention shall be determined only by the appended claims and their equivalents.

What is claimed is:

1. A method of fabricating a liquid crystal display provided with thin film transistors consisting of gate electrodes, a gate insulating film, an active layer, an ohmic contact layer, source and drain electrodes on a transparent substrate, said method comprising the steps of:

forming a passivation layer made from an organic insulation material on the transparent substrate to cover the thin film transistors;

patterning the passivation layer to define a contact hole for exposing the drain electrode and cleaning the surface of the passivation layer with an ultraviolet ray to form a buffer layer having a hydrophile property; and

forming a pixel electrode on the buffer layer in such a manner to be contacted with the drain electrode via the contact hole.

2. The method according to claim 1, wherein the passivation layer is made from an organic insulation material having a small dielectric constant such as BCB (β-stagged-divinyl-siloxane-benzocyclobutene), acrylic organic compound or PFCB (perfluorocyclobutane).

3. The method according to claim 1, wherein the passivation layer is cleaned with an ultraviolet ray of about 100 to 200nm at a normal pressure to form the buffer layer.

4. The method according to claim 3, wherein the buffer layer is made from SiO_2 or other oxide.

5. The method according to claim 4, wherein the buffer layer is formed to have a thickness of 10 to 50Å.

6. The method according to claim 1, wherein the pixel electrode is made from an indium tin oxide (ITO: Indium Tin Oxide), a tin oxide (TO: Tin Oxide) or an indium zinc oxide (IZO: Indium Zinc Oxide).